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NEWS OF SOVIET TOXICOLOGICAL STUDIES

- USSR -

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NEWS OF SOVIET TOXICOLOGICAL STUDIES

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[This report consists of translations of two articles taken from the Russian periodical Vrachebnoye delo (Medical Affairs), No 2, 1960, Kiev.]

The Effect of Small Concentrations of Toxic Substances on Efficiency

[Following is a translation of an article by Yu. I. Vasilenko taken from the above-listed periodical, pages 173-176.]

The modern practice of setting output rates, as applied to rest periods, takes into consideration the time required by workers for their personal needs and rest in connection with fatigue caused by labor, the effect of high temperatures, etc. The presence of harmful chemical substances as a factor of the production environment has not been taken into account to the proper extent. The practice has usually been limited to specifying that the rest time shall be increased by 10 percent in the case of workers employed where there are particularly harmful conditions requiring the use of respirators or gas masks.

However, the literature indicates that even permissible concentrations of harmful substances which do not cuase visible changes in health do exert a harmful influence on the muscular strenght, efficiency, and higher nervous activities of humans and animals.

Obtained experimentally, data have also been accululated on the effect of low concentrations of harmful chemical substances on efficiency.

We were given the assignment of conducting special research on this problem. The experiment was conducted on 20 2-month-old male white mice, weighing from 28 to 30 grams. The animals were divided into two groups of 15 and 5 mice.

During the experiment the first group was subjected to the action of small doses of poison and was also given physical exercise. The second group was given only physical exercise.

Three series of tests were made.

In the first series we studied changes in the dynamics of efficiency in relation to physical exercise in the animals' usual living conditions. These experiments provided a definite control background of the changes in efficiency under normal conditions.

The second series of studies of changes in efficiency was conducted to note the effect of small doses of a harmful chemical substances, given daily over a period of one hour, on the animal organism.

We carried out the third series of studies with the objective of studying the effect of additional rest on efficiency under conditions of the continuous influence of small doses of poison (the M-81 organic phosphorus preparation from a group of insecticides).

In the second and third series of experiments, the animals were daily subjected (for 40 days) to 60 minutes of exposure to vapors of this poison in concentrations varying from 0.0002 to 0.0005 milligrams per liter of air at temperatures of 17-18 degrees Centigrade.

The concentrations of poison used are subthreshold, as they cause only insignificant, short-lived changes in the cholinesterase activity of cats, which are very sensitive to this poison.

Endurance measured by the duration of the period of muscular work served as the index of efficiency in our studies. The work done by the animals consisted in static tension of their muscular systems, their bodies being in a strained position. A mouse was made to hang by its paws from a vertically fastened support. After 5 minutes the animal was given 5 minutes of rest. Then the mouse was made to hang by its paws until it became exhausted and fell from the support. As previously stated, the efficiency of all 20 mice in both groups was investigated every day. Each animal was obliged to work 30 minutes after poison being given, at which time it received its usual ration.

In the first series of studies, prior to the introduction of the poison, it was noted that all 20 of the mice were capable of increasing their efficiency through the training given. The period during which the animals could perform their work increased from several minutes on the first few days of the experiment to 1 or 2 hours by the end of the first series.

In the second series of studies, when the animals were subjected to small doses of the poison, we observed a sharp divergence in the working periods of those animals which had been poisoned and those which had not been.

An increase in efficiency (training) was noted during the first 10 studies (first series) in both groups of animals. Beginning with the eleventh study of the second series, that is, with the poisoning of the second group of animals, there was a divergence in changes in the indexes of efficiency. Thus the work periods continued to increase in the group which had not been poisoned. On the other hand, the work period of those animals which had been subjected to poisoning gradually decreased.

On the basis of the studies made, one can conclude that the action of small concentrations of poison reduced the endurance of the animals and promoted the earlier onset of fatigue.

In order to study the question of the retention of efficiency in connection with the action of harmful chemical substances, we shall explain the relative influence of increased rest periods.

In the third series of studies the animals were divided into three groups in accordance with their degree of tolerance to the poison. The first group included six mice in which a decrease in efficiency was noted

from the very first days of the poisoning, the second group (six mice) included animals which retained their efficiency at approximately the former level for about 10-20 days of poisoning, and the third group (three mice) included animals which retained their capacity to prolong their work periods for 20 days of poisoning.

We studied in two stages the effect on efficiency exerted by increased rest periods.

Increasing the rest time brought to a halt the loss in efficiency, which was replaced by a new increase in efficiency. It should be noted, however, that the general level of efficiency still remained below the initial level prior to the poisoning.

Observations of the general condition and behavior of the animals showed that the small subthreshold doses of the harmful chemical substance we employed did not cause any noticeable pathological changes in their organisms. All of them, both those subjected to poisoning and those which had not been, retained the same high degree of activity throughout the entire experiment.

Control weighing every 10 days in the morning hours before feeding showed insignificant fluctuations in weight within the limits of 1-2 grams in different individuals from both groups of mice. Further observations during the 4 months, right up through completion of the experiment, did not indicate any differences at all in the condition of the animals.

Not having exerted any visible harmful influence on the living organism, the small concentrations of harmful chemical substances were nevertheless not without influence on the organism, causing noticeable changes in its functions.

In connection with not only work but also the effect of small (permissible) concentrations of harmful chemical substances, further studies are essential for solving the problem of additional time for rest.

Early Manifestations of Tetraethyl Lead Intoxication

[Following is a translation of an article by V. Ye. Lyubomudrov taken from the above-listed periodical, pages 175-178.]

A number of studies have been made of the clinical manifestations of tetraethyl lead intoxication, but its early symptoms have not been adequately studied.

In joint investigations conducted with V. V. Nikiforov of 167 persons who had been subjected to microdoses of tetraethyl lead, we directed our attention to the significant frequency (15.4 percent) of those complaining of a "pounding" pain the region of the temples which grew stronger when walking, when "every step was felt in one's head." This observation gave us grounds for more careful study of the state of arterial pressure in persons who had been subjected to the effects of tetraethyl lead.

We studied 78 persons who worked in enclosed spaces containing 0.001-0.0002 milligrams of tetraethyl lead per liter of air. The influence of vibrations, noise, and unfavorable weather factors were not studied. Twenty-four persons had worked under these conditions for about 3 months; 41 persons from 3 to 6 months; and 13 persons more than 6 months.

The maximum pressure in the temporal artery was measured by means of a sphygmomanometer with a special rubber cuff; the pressure in the brachial artery (on the same side) was measured with the same apparatus, but with a different rubber cuff. Working with the findings of S. P. Botkin, as well as those of G. I. Markelov (1939) and G. I. Markelov and S. I. Rovinskiy (1940), on the volume and pressure of blood in the temporal artery, we were able to judge the volume and pressure of blood in the cerebral blood vessels.

In order to determine the state of the vegetative innervation, we made symmetrical galvanometric and moisture (sweat) measurements of the skin with the aid of N. N. Mishchuk's apparatus.

It should be noted that cases of chronic tetraethyl lead intoxication have frequently been observed in workers with similar occupations and service of more than 2 or 3 years (N. V. Grebenshchikov). The indexes of symmetrical perspiration measurements and galvanometric measurements fluctuated markedly (an excess of 2.5 times was noted in some instances). A comparison of these indexes is presented in Table 1 (for galvanometric measurements) and in Table 2 (for perspiration measurements).

TABLE 1

Period of Study	Total Studied	Indexes of galvanometry: No difference	Excess of 1.2-1.5 times	Excess of 2.0-2.5 times	Excess of 3.0-4.0 times
Before starting work	65	11	47	7	--
After 3 months	65	6	10	2	47
After 6 months	45	1	17	13	14
More than 6 months	13	--	--	5	8

As may be seen from the tables presented here, the frequency and degree of galvanic and perspiration asymmetry increased markedly even though the usual symptoms of tetraethyl lead intoxication (bradycardia, hypotension, loss of weight and sleep, etc.) were not noted. Only 8 of the 45 persons who worked 6 months, and 7 of the 13 persons who worked more than 6 months, complained of periodic headaches with characteristic localization.

The brachial arterial blood pressure of those who had worked up to 6 months did not go down. A decrease in the maximum arterial blood pressure was noted in 4 of the 16 persons who had worked more than 6 months, and a decrease in the minimum was noted in 9 of them. Control studies of the arterial blood pressure, both temporal and brachial, before starting work were not made of those with the above work experience (more than 6 months). It was determined repeatedly in all the other cases.

TABLE 2

Period of Study	Total studied	Indexes of perspiration measurement: No difference	Excess of 1.2-1.5 times	2.0-2.5 times	3.0-4.0 times
Before starting work	65	6	48	11	--
After 3 months	65	3	6	45	11
After 6 months	45	--	4	26	15
More than 6 months	13	--	1	6	6

The figures for the temporal arterial blood pressure are presented in Table 3.

TABLE 3

Period of Study	Total studied	Ratio of Maximum temporal and brachial arterial blood pressure: 1:1.5	1:2	1:2.5	1:3
Before starting work	65	12	37	16	--
Within 3 months	65	7	28	19	11
Within 6 months	40	2	11	17	10

These data indicate a decrease in the ratio of the temporal and brachial arterial blood pressure. Other symptoms of tetraethyl lead intoxication were not noted in these investigations. Later, as shown by investigation of the 13 persons with a work longevity of more than 6 months, hypotension was also noted in measurements of the brachial arterial blood pressure. According to N. V. Grebenshchikov's observations, chronic tetraethyl lead intoxication occurred frequently in persons with a work longevity of 2 to 5 years.

All the foregoing gives us grounds for assuming that vegetative asymmetry and a high degree of hypotension should be regarded as early manifestations of tetraethyl lead intoxication.

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